An Overview of Railroad Modeling and Simulation

2nd Annual Florida Transportation Data Symposium

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Industry background

- Approximately $70B revenue per year amongst US railroads.
- U.S. has best-in-the-world freight rail system.
- 56 tons of freight are moved per person in America each year. Over the next 30 years that amount is expected to increase more than 33 percent.

Source: Association of American Railroads (AAR)

Investment

Railroading is VERY, VERY, VERY capital intensive:

- From 1980 through 2014, freight railroads reinvested $575 billion in equipment and infrastructure.
- In 2015, freight railroads are projected to spend $29 billion on equipment and infrastructure.
- Railroads reinvest at six times the rate of the average manufacturer.

Source: Association of American Railroads (AAR)

Industry challenges

- Railroads are risk averse.
  - Have been operating for 150+ years in the U.S. Very good at what they do. Don't like to "rock the boat."
  - Prefer changes to be incremental rather than "clean sheet" though the latter is not unheard of.
- Service changes can occur frequently and quickly. Railroads move s-l-o-w-l-y.
- Perfect opportunity for Modeling and Simulation (M&S): low-risk, low-cost and can be fast.

Who does railroad M&S?

- The railroads (operators)! Generally embedded in a Service Design, Network Planning or an Operations Research group.
- Policy makers
- Consultancies. Often represent one of the above two groups.
- Vendors

What problems are we trying to solve?

- Crew and equipment scheduling (not unlike an airline)
- Block assignment
- Train scheduling
- Facility location
- Infrastructure investment
- many more . . .

What tools do we use?

The “old” tools . . .

Microsoft Excel

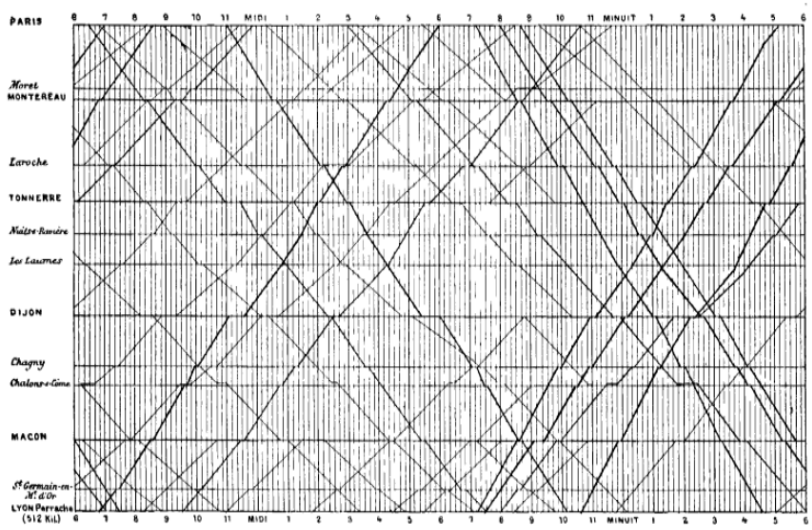

Fig. 5. — Graphique de la marche des trains sur un chemin de fer, d'après la méthode de Ilry.

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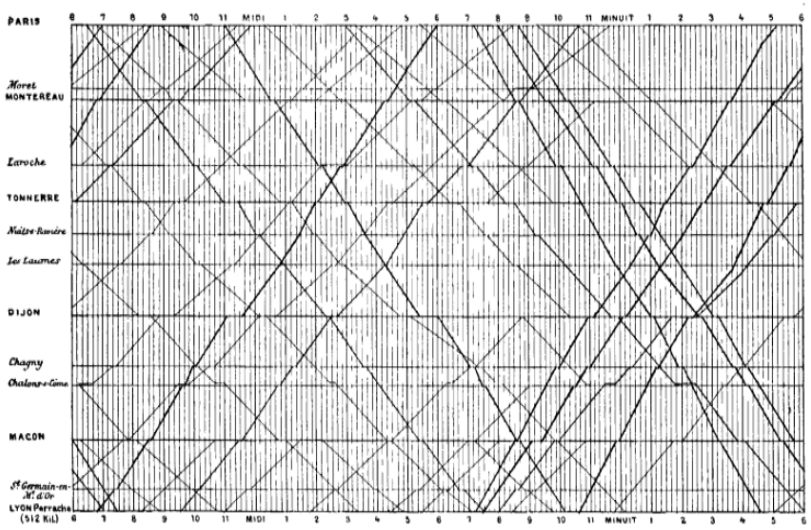

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The “new” tools . . .

Rail Traffic Controller™

MULTIRAIL™

TRAINMAX OPTYM

TDS OnTrack

Arena® Simulation Software

Example: Rail Traffic Controller (RTC)

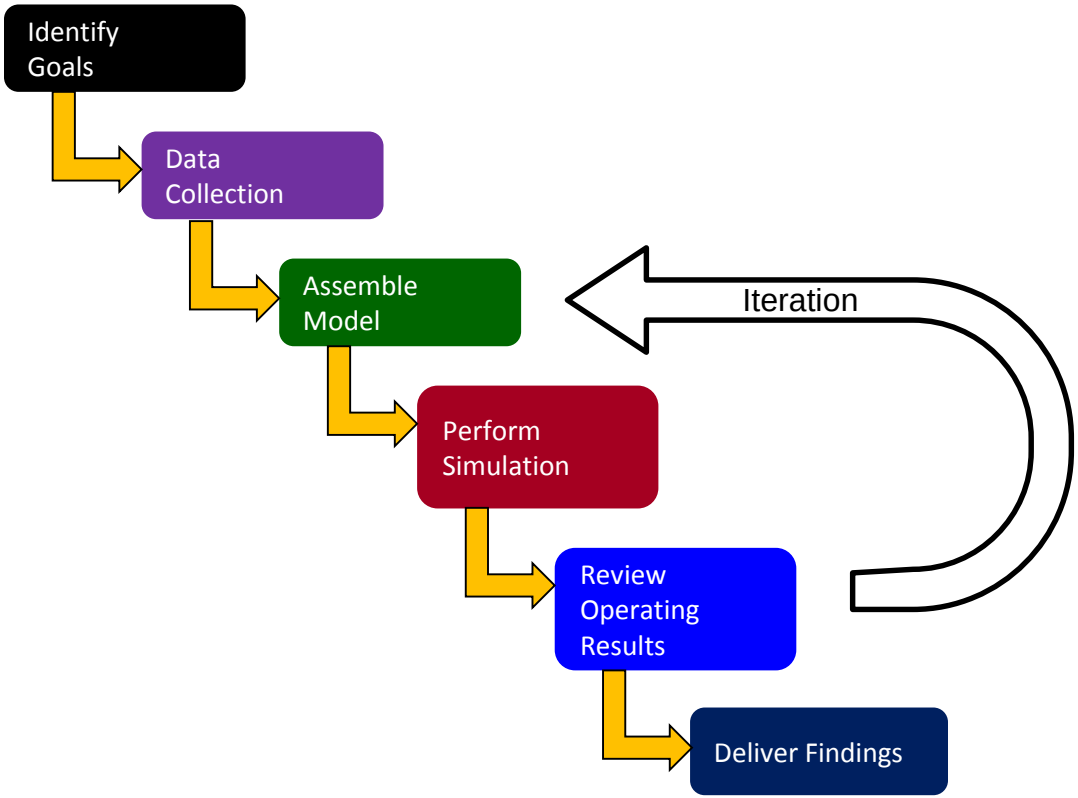
- Discrete event simulation software developed by Berkeley Simulation Systems.
- Used specifically for rail environments (freight, passenger, commuter, transit).
- Allows for very precise results in mixed passenger/freight corridors. Lots of interest in mixed corridors in past decade.

Example: Rail Traffic Controller (RTC)

RTC is primarily used to:

- Analyze impact of infrastructure changes such as adding additional main track and new interlockings.
- Analyze impact of strategic service plan changes including modifying the frequency of trains or the characteristics of trains.
- Analyze impact of tactical service plan changes such as accommodating major track work and outages.

M&S Process


Identify Goals
Data Collection
Assemble Model
Perform Simulation
Review Operating Results
Deliver Findings
Iteration

M&S Process

Identify Goals

- Adding new track to increase main-line fluidity?
- Adding a new train to support a new customer?
- Expanding a yard to support more trains?

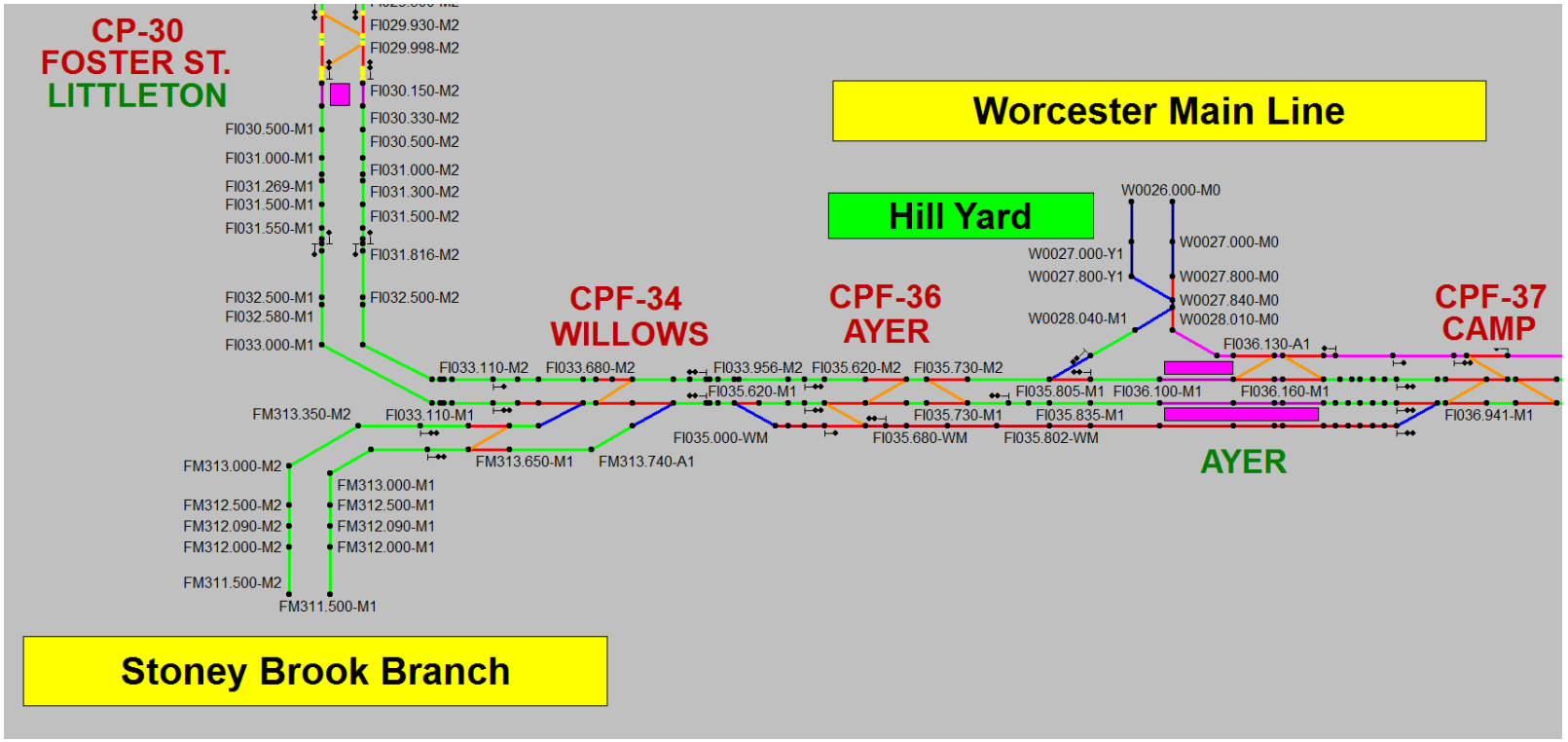
Data Collection

Sources:

- Timetables
- Track charts
- Rule books
- Dispatching system

M&S Process

Assemble Model



Identify Goals → Data Collection → Assemble Model → Perform Simulation → Review Operating Results → Deliver Findings

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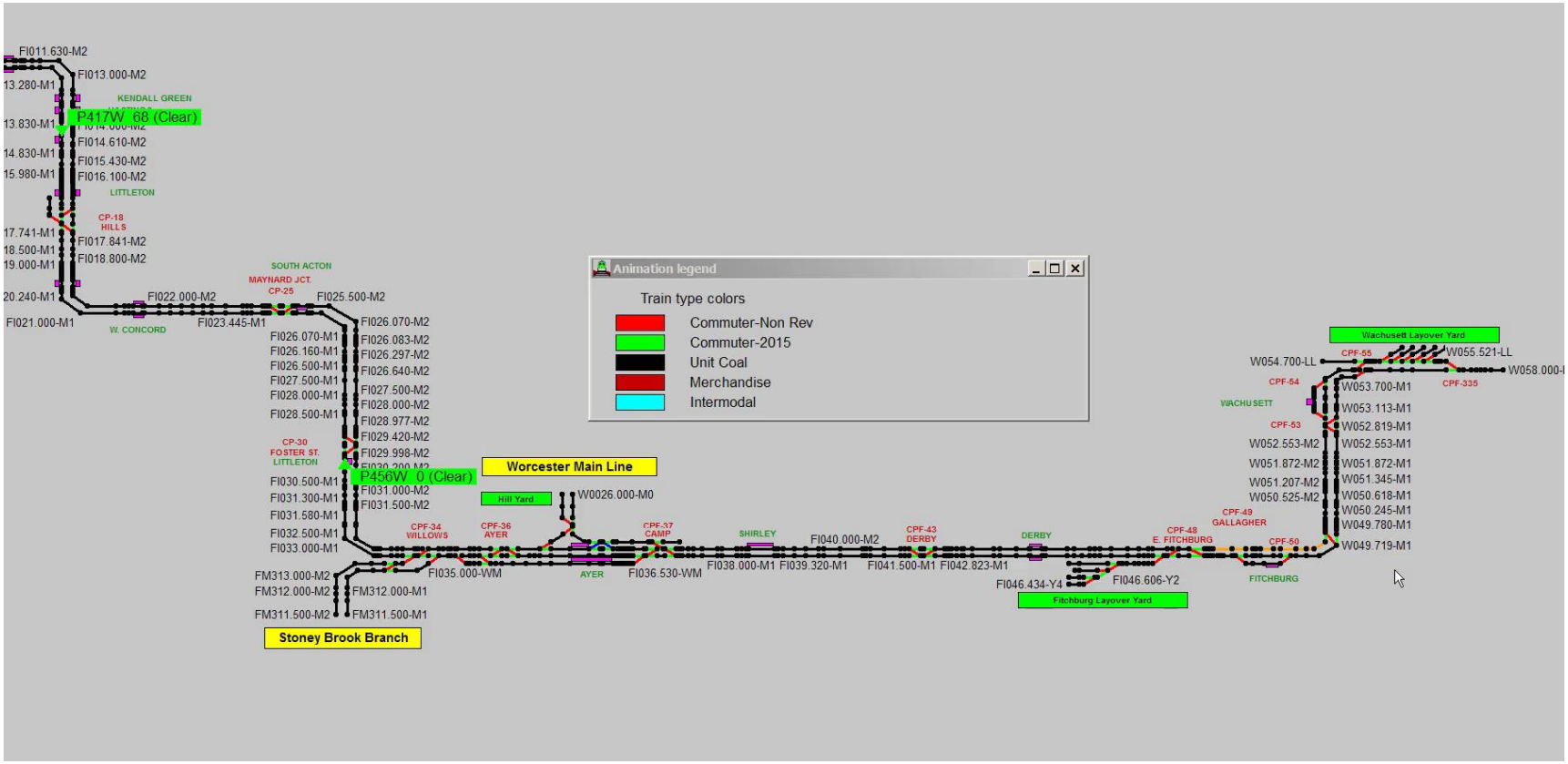
M&S Process

Perform Simulation



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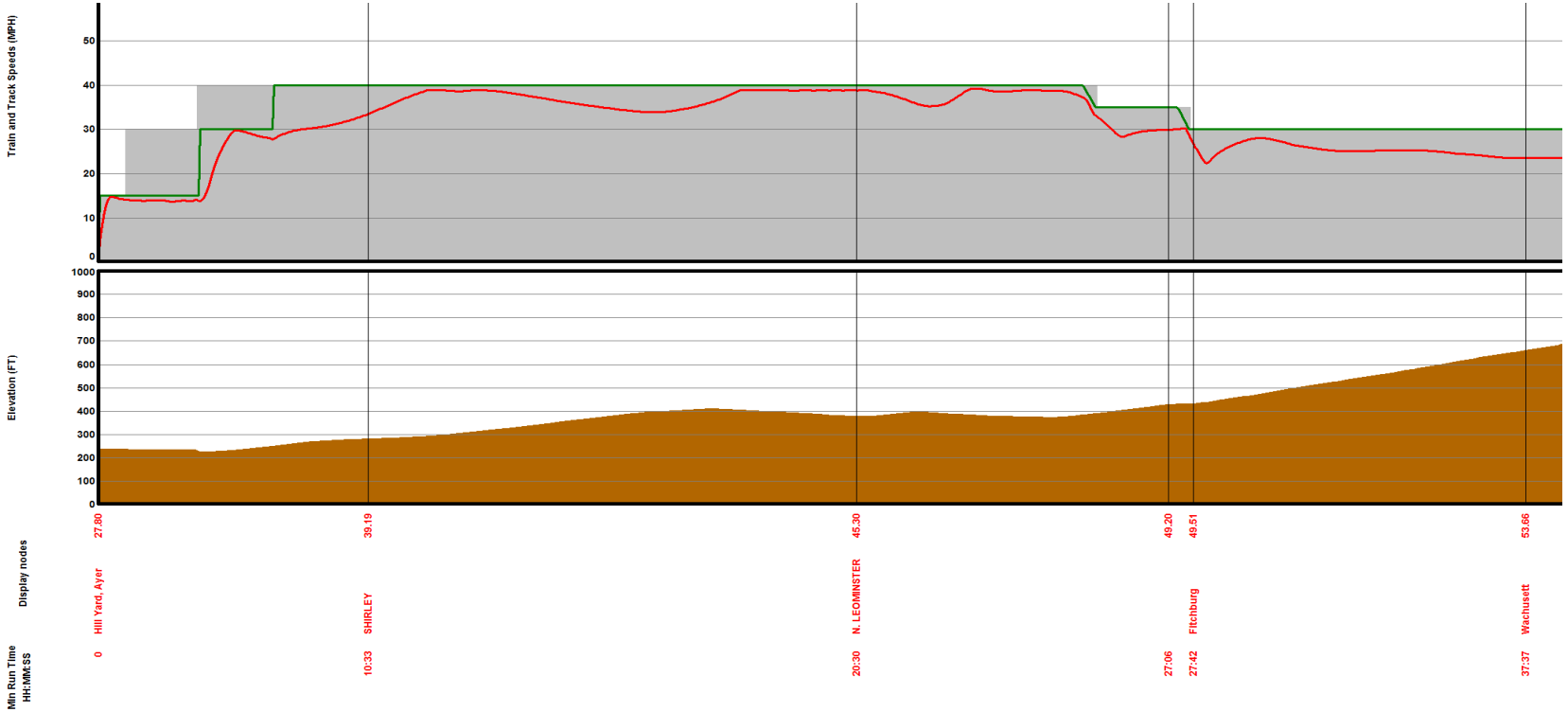
M&S Process

Review
Operating Results



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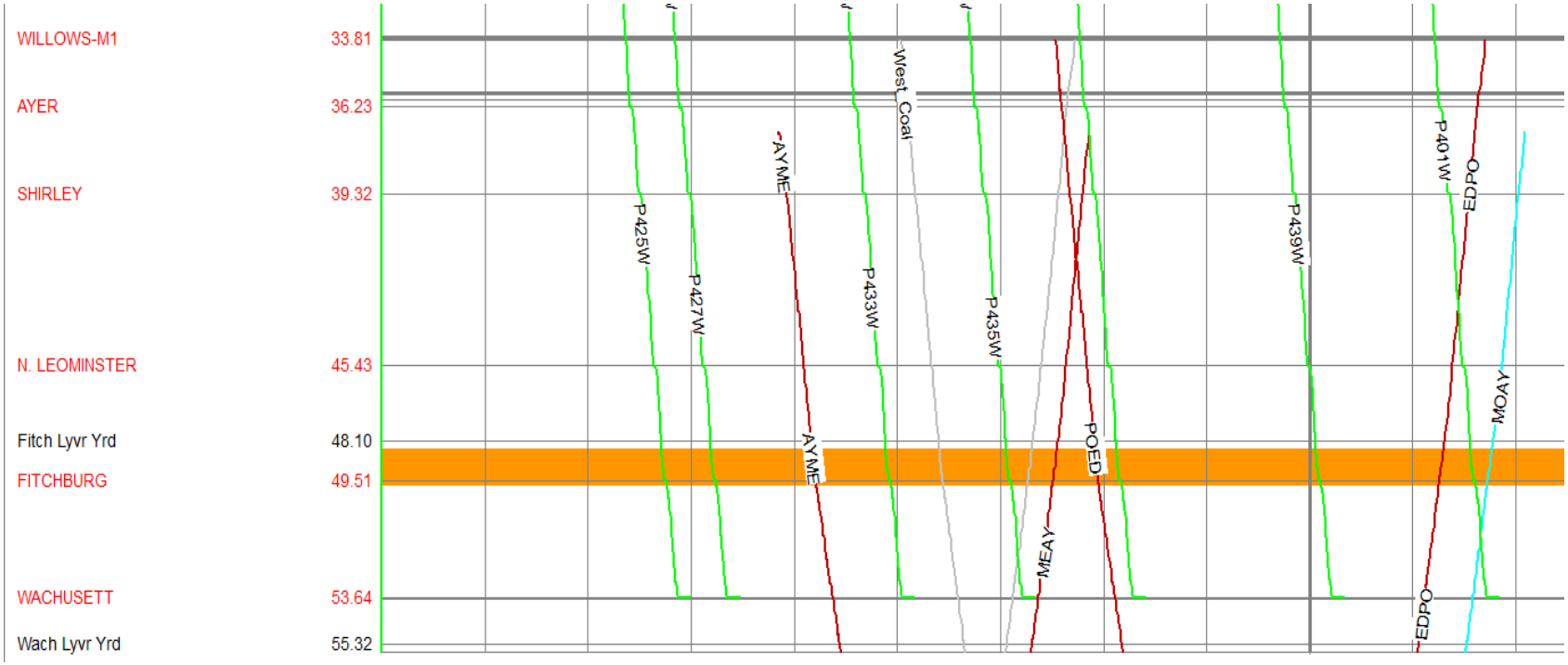
M&S Process

Review
Operating Results



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M&S Process

Deliver Findings

- Before delivering the results ask:
  - Do the results directly address the required objectives? If not, STOP.
  - Are there major problems which affect the simulation's operation? If yes, STOP.
  - Are any remaining "smaller" issues documented? If not, STOP. It's rare that a large model is truly "complete." There's almost always variables that can't be modeled. RTC has been in development since 1995 and there are some real-world conditions that it does not support.
  - Finally, perform a gut-check. Based on your AND other's work, do the results seem reasonable? If not, have someone else take a look at it.
- Then – deliver the results to the stakeholders.

M&S customers, educators and suppliers based in Florida

Final Thoughts

- Do manage expectations. M&S is a valuable tool that provides detailed insight. But, it is not a silver bullet.
- Don't believe that M&S can provide THE answer. It just provides an input to THE answer.
- Do beware of the "garbage to gospel" phenomenon. Bad data run through a $500k piece of software doesn't mean the results are valid.

Thank you for your attention!

Please feel free to ask questions today or via email: pwindschmitt@hntb.com